

**VERY SMALL DIAMETER OPEN-CELL POLYMER FOAMS AND THEIR
MANUFACTURING PROCESS**

DETAILED ACTION

Response to Amendment

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
2. Any rejections stated in the previous Office Action and not repeated below are withdrawn.
3. It is noted that claims 1-5 have been cancelled. Claim 6 has been amended for improved clarity and grammatical accuracy.
4. No new rejections have been made over previously rejected claims. For this reason it is proper to make the present action FINAL.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 6-11, 14, 17, and 20-21 are rejected under 35 U.S.C. 102(b) as being anticipated by Dyer (6,160,028).

1. Dyer teaches a polymeric foam formed by polymerizing a high internal phase emulsion (HIPE) comprising an (a) oil phase which comprises from 0 to 70% styrene based comonomers (styrene or ethyl styrene) (column 16, lines 15-21) and which may further comprise 2 to 50% divinylbenzene (column 16, lines 41-59) and (b) an aqueous phase which may comprise an metal sulfate electrolyte (column 18, line 62- column 19, line 1). The volume to weight ratio of aqueous phase to oil phase is least 3:1 (meaning the aqueous phase comprises at least 74% of the total volume of the 2 phases). The high internal phase emulsion may further comprise a sodium persulfate polymerization initiator (columln 19, lines 10-15) and an emulsifier which may comprise a diglycerol ester derived from monooleate (column 17, lines 11-18). The emulsifier is present in an amount of from 2 to 20% by weight based on the weight of the oil phase (column 17, lines 40-42). The foam product produced from the HIPE composition may be microcellular (have cell diameters less than 10 μm) (column 10, lines 10-11) and may have a density of less than 250 mg/cc and preferably from 12 to 80 mg/cc (column 10, lines 62-64).

2. The HIPE of Dyer is formed by combining the oil and water phases, in which the oil phase typically contains the monomers, comonomers, crosslinkers, and/or emulsifiers and the water phase contains the electrolytes and polymerization initiators, and subjected the combined phases to shear agitation in order to disperse the water droplets to such an extent that the resulting polymeric foam will have the requisite structural characteristics (column 19, line 59 - column 20, line 7). The agitation will frequently involve the use of a mixing or agitation device such as a pin impeller. Shear

is typically applied by a pin impeller to the combined oil/water phase stream at an appropriate rate. Once formed, the stable liquid HIPE can be withdrawn from the mixing chamber.

3. A porous, water-filled HIPE foam is then obtained after polymerization/curing in a reaction vessel such as a cup or tub (column 20, lines 58-60). The polymerization conditions involve maintaining the HIPE at elevated temperatures above 30°C (column 20, lines 49-51, pertaining to instant claim 20). The polymerized HIPE foam is then subjected to subsequent treating/washing and dewatering (drying) steps (column 20, lines 62-63). Samples of the HIPE foam are typically washed in water and alcohol (column 22, lines 59-50, pertaining to instant claim 21).

4. While Dyer may not expressly teach that exposing the emulsion to shear “reduces the diameter of the water bubbles contained in the emulsion,” Dyer teaches the exact same components may be used in the exact same amounts as taught in instant claim 6, and further teach that the composition is exposed to shear. Therefore, one of ordinary skill in the art would recognize that the composition of Dyer, when exposed to shear, would inherently have reduced-diameter water bubbles.

5. Claim 16 recites a property of the water used for the aqueous phase. The prior art teaches water comprising the same amount of electrolyte. Case law holds that a material and its properties are inseparable. *In re Spada*, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). The examiner takes official notice that the resistivity value of water is well known to be 18.18 megaohms.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 13, 15, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dyer (6,160,028).

8. Dyer teaches the foam and process as applied to claims 1 and 6 above, and further teaches that the polymer foam may have a mean diameter of not more than 150 μm (column 11, lines 19-20) and that the oil phase of the HIPE may comprise 80 to 98% by weight monomer component (such as styrene-based comonomers and divinylbenzene comonomer) and from 2 to 20% by weight emulsifier (column 17, lines 40-42). These ranges overlap the ranges of instant claims 4 and 5. Dyer also teaches that the electrolyte comprise from 0.2 to 20% by weight of the water phase of the HIPE emulsion (column 19, lines 2-5) and the polymerization initiator (which is generally added to the water phase of the HIPES) may comprise from about 0.001 to 10 mole percent based on the total moles of polymerizable monomers in the oil phase (column 19, line 10-11 and 22-25). These ranges overlap the ranges of instant claims 13 and 15, respectively.

9. It is well settled that where the prior art describes the components of a claimed compound or compositions in concentrations within or overlapping the claimed concentrations a *prima facie* case of obviousness is established. See *In re Harris*, 409 F.3d 1339, 1343, 74 USPQ2d 1951, 1953 (Fed. Cir 2005); *In re Peterson*, 315 F.3d 1325, 1329, 65 USPQ 2d 1379, 1382 (Fed. Cir. 1997); *In re Woodruff*, 919 F.2d 1575, 1578 16 USPQ2d 1934, 1936-37 (CCPA 1990); *In re Malagari*, 499 F.2d 1297, 1303, 182 USPQ 549, 553 (CCPA 1974).

10. As to claim 22, Dyer teaches subjecting the foam to temperatures of about 60°C to 200°C for thermal drying/dewatering of the HIPE foam (column 21, lines 21-25). It would have been obvious to one of ordinary skill in the art that “thermal drying” may comprise an oven because ovens are common chemical equipment used as a means for drying.

11. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dyer (6,160,028) and further in view of Shinozaki et al. (US 5,616,413).

12. Dyer teaches the composition and process as applied to claims 1 and 6 above, but does not expressly teach that the electrolyte used is aluminum sulfate.

13. However, Shinozaki et al. teach a process for polymerizing a styrene monomer in an aqueous medium in the presence of polymerization initiator(s) and suspension stabilizer(s) (emulsifier), said process of which comprises adding an electrolyte to the aqueous medium at a concentration of 0.02 to 5.0 mol/l based on the amount of

aqueous medium (column 2, lines 7-10). The electrolyte may comprise sodium chloride, calcium chloride, magnesium sulfate, sodium sulfate, or aluminum sulfate (column 4, lines 59-65), all of which ionize aqueous solutions (column 4, lines 59-60).

14. In view of Shinozaki et al.'s recognition that aluminum sulfate and calcium chloride, sodium chloride, magnesium sulfate, or sodium sulfate (all of which are taught in Dyer) are equivalent and interchangeable, it would have been obvious to one of ordinary skill in the art to substitute calcium chloride, sodium chloride, magnesium sulfate, or sodium sulfate with aluminum sulfate and thereby arrive at the present invention. Case law holds that the mere substitution of an equivalent (something equal in value or meaning, as taught by analogous prior art) is not an act of invention; where equivalency is known to the prior art, the substitution of one equivalent for another is not patentable. See *In re Ruff* 118 USPQ 343 (CCPA 1958).

15. Claims 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dyer (6,160,028) and further in view of Clear et al. (US 6,750,261).

16. Dyer teaches the polymeric foam and process as applied to claims 1 and 6 above but does not expressly teach that the emulsion is subjected to shear by injecting the emulsion into a container by means of a syringe connected to a pulser capable of delivering a pressure above atmospheric pressure, that the container into which the emulsion is injected is a mold having the shape and dimensions of the foam to be

manufactured, or that the syringe is provided with a needle having an internal diameter of 150 microns to 1 mm.

17. However, Clear et al. teach a process for making a HIPE foam which may comprise styrenic monomers, crosslinking agents, and emulsifiers (such as sorbitan monooleate) in an oil phase and electrolytes in an aqueous phase and in which the aqueous phase may further comprise a polymerization initiator (see column 4, line 4; column 4, lines 46-49; column 5, lines 7-8; column 7, line 17-19). The oil phase comprises less than 26% by volume of the emulsion (column 7, lines 15-16). The foam produced has a cell size of preferably 0.1 to 10 micrometers. Clear et al. further teach that the HIPE emulsion is injected with a glass syringe equipped with a 20-gauge (less than 1 mm) needle into polypropylene channels (molds) in which the foam was then cured using heat (column 23, lines 3-9).

18. It would have been obvious for one of ordinary skill in the art at the time the invention was made to subject the emulsion of Dyer to shear (as taught in Dyer) using the syringe equipped with a 20-gauge needle as taught in Clear et al. because properties of foams such as cell size, cell size distributions, and number of windows are influenced by the agitation methods and speeds used to make the emulsions (column 9, lines 48-51). The agitation methods of Clear et al. would produce cells with a small size and uniform distribution which is desired by Dyer (See Dyer, column 10, lines 10-11 and Clear et al., column 12, lines 11-12, as well as Clear et al., column 9, lines 49-51 and column 9, lines 58-61).

Response to Arguments

7. Applicant's arguments filed April 21, 2010 have been fully considered but they are not persuasive.
8. Applicant argues Dyer teaches that the purpose of shearing is to disperse the water phase droplets in order to form an emulsion and that amended claim 6 requires a separate and additional step "b" of "reducing the diameter of water bubbles contained in the emulsion formed during step "a" (mixing step of instant claim 6). Applicant asserts that Dyer does not disclose or teach reducing the diameter of water bubbles contained in the emulsion formed during the mixing step. Applicant further argues that Dyer does not disclose the production of an "exclusively hydrocarbon copolymer" as required in instant claim 6.
9. Applicants' argument is not persuasive. As indicated by the applicant, the MPEP teaches that a claim is anticipated under 35 U.S.C 102 (b) only if each and every claim element is found, either expressly or inherently described in a single art reference. While Dyer may not expressly teach that exposing the emulsion to shear "reduces the diameter of the water bubbles contained in the emulsion," Dyer teaches the exact same components which may be used in the exact same amounts as taught in instant claim 6, and further teach that the composition is exposed to shear. Therefore, one of ordinary skill in the art would recognize that the composition of Dyer, when exposed to shear, would inherently have reduced-diameter water bubbles.
10. In response to applicants' argument that Dyer does not teach the production of "an exclusively hydrocarbon copolymer," the copolymer of Dyer comprises from 0 to

70% styrene based comonomers and may further comprise 2 to 50% divinylbenzene. A copolymer comprising 70% styrene and 30% divinylbenzene, which falls within the limitations described in the specification of Dyer, is inherently an “exclusively hydrocarbon copolymer.” In addition, Applicant has not provided evidence that the copolymers of Dyer are not “exclusively hydrocarbon copolymers.”

11. Applicant further argues that because claims 13, 15, and 22 depend on claim 6, the rejections of claims 13, 15, and 22 cannot be obvious. For the reasons provided above, claim 6 is anticipated by Dyer and therefore, applicants' argument is not persuasive.

12. Applicant argues that because claim 12 depends on claim 6, the rejections of claims 13, 15, and 22 cannot be obvious. For the reasons provided above, claim 6 is anticipated by Dyer and therefore, applicants' argument is not persuasive.

13. Applicant asserts that Clear, like Dyer, does not teach the reduction of bubble diameter and therefore, that the rejection claims 17-19 is not obvious under 35 U.S.C. 103(a) over Dyer in view of Clear. As discussed above, While Dyer may not expressly teach that exposing the emulsion to shear “reduces the diameter of the water bubbles contained in the emulsion,” Dyer teaches the exact same components in the exact same amounts as taught in instant claim 6, and further teach that the composition is exposed to shear. Therefore, one of ordinary skill in the art would recognize that the composition of Dyer, when exposed to shear, would inherently have reduced-diameter water bubbles.

14. As stated in the rejection above, Dyer anticipated instant claim 6, and Clear teaches the limitations of instant claims 17-19. It would have been obvious for one of ordinary skill in the art at the time the invention was made to subject the emulsion of Dyer to shear (as taught in Dyer) using the syringe equipped with a 20-gauge needle as taught in Clear et al. because properties of foams such as cell size, cell size distributions, and number of windows are influenced by the agitation methods and speeds used to make the emulsions (column 9, lines 48-51). The agitation methods of Clear et al. would produce cells with a small size and uniform distribution which is desired by Dyer (See Dyer, column 10, lines 10-11 and Clear et al., column 12, lines 11-12, as well as Clear et al., column 9, lines 49-51 and column 9, lines 58-61).

Conclusion

15. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

16. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KARA NEGRELLI whose telephone number is (571)270-7338. The examiner can normally be reached on Monday through Friday 9:30 am EST to 6:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Randy Gulakowski can be reached on (571)272-1302. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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